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Think Inside the Box: Using Tables to Understand Number Patterns [4th grade]

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UNDERSTANDING BY DESIGN

Unit Cover Page

Unit Title: Think Inside the Box: Using Tables to Understand Number Patterns

Grade Level: 4th

Subject/Topic Area(s): Math

Designed By: Kristen Lesher & Carrie Susong

Time Frame: 2 weeks (10 days)

School District: North East Independent School District

School: Hardy Oak Elementary

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Brief Summary of Unit: This two-week unit introduces students to more sophisticated number patterns and teaches students how to describe the relationship between two sets of data in a table. In the unit, students will identify patterns in everyday situations, record those patterns in the form of a table, and begin to use arithmetic expressions as well as other strategies to describe relationships between sets of data in a table. The performance task will ask students to create tables comparing age relationships. Students will describe the relationship between sets of data in each table using both written and verbal communication.

Unit: Think Inside the Box: Using Tables to Understand Number Patterns
Grade: 4th

Stage 1: Desired Results

Understandings

Students will understand that…

- Multiplication and division facts are expressions of number patterns.
- Number patterns exist in everyday situations.
- There is a difference between identifying a number pattern and identifying the relationship between two sets of data.

Essential Questions

- What is a pattern?
- How do we identify number patterns?
- How can we recognize number patterns in everyday situations?
- How can we determine the process involved in creating a relationship between two sets of data?

Knowledge

Students will know…

4.6A [how to] use patterns and relationships to develop strategies to remember basic multiplication and division facts (such as the patterns in related multiplication and division number sentences (fact families) such as 9x9 = 81 and 81 ÷ 9 = 9)

4.6B [how to] use patterns to multiply by 10 and 100

4.7 [how to] describe relationship between two sets of related data ~~such as ordered pairs~~ in a table

4.16A [how to] make generalizations from patterns or sets of examples and nonexamples

Skills

Students will be able to…

4.16B justify why an answer is reasonable and explain solution process

4.14A identify mathematics in everyday situations

4.14B solve problems that incorporate understanding the problem, making a plan, carrying out the plan, evaluating solution for reasonableness

4.14C select or develop appropriate problem-solving plan or strategy, including ~~drawing a picture,~~ looking for a pattern, ~~systematic guessing and checking, acting it out,~~ making a table, ~~working simpler problem, or working backwards~~ to solve problem

4.14D use tools such as real objects, manipulatives, and technology to solve problems

4.15A explain and record observations using objects, words, pictures, numbers, and technology.

Stage 2: Assessment Evidence

Performance Task:

From Age to Age. Using chart paper, students will create many tables comparing age relationships. Students will describe the relationship between the input and output for each table using pictures, numbers, and words. After completing all tables and written explanations, students will choose 1 table to present to the class.

The performance task will be broken down into the following steps:

Step 1:
Students will choose 2 family members and 1 pet and find out their current ages and the year they were born. Students will create 3 separate tables that compare their age to the age of each family member/pet they have chosen.

Step 2:
Students will use the information chart provided to create a table that compares human years to pet years for their pet.

Step 3:
Students will use the "Mix & Match" chart provided to create 2 more separate tables. Students may choose to compare their age to the age of one of the items from the "Mix & Match" chart, or they may choose to compare 2 items from the chart. Students will need to use the given birth years to calculate the age of their selection before they organize their information in a table.

Other evidence:

- Class discussions
- Observations of student work during Investigations activities
- Student written reflections on Investigations activities
- Individual student assessments ("Rules Rule Part 1" and Patterns Unit Assessment)

Stage 3: Learning Activities

(Steps taken to get students to answer Stage 1 questions and complete performance task)

Warm-up activities to be used throughout the two-week unit:

- "Disappearing Digits" (Students work to find the missing number in a number sentence.)
- "Mystery Operations" (Students discover operations that will make a number sentence true. Ex.: 6 5 1 = 10.)
- Silent multiplication with multiples of 10
- "Table Match" (Students work to match an arithmetic expression to sets of data in different tables.)

Day 1: Input/Output Machine. Show students video clip demonstrating input and output using a machine (Ex.: Babes in Toyland, Charlie and the Chocolate Factory, etc.). Introduce terms **input** and **output** to the students. Use a refrigerator box as an "input/output machine" and have student volunteers take turns holding a number card with the input number on the front and an output number on the back. Student volunteers will enter the box with the input number showing and exit the box with the output number showing. Engage students in discussion of what operation(s) were used to change the number. Accept all possible answers and discuss any impossible answers. (Cards displaying pictures, arrays, and/or numbers will be used.) Encourage students to look at the relationship between input and output in different ways. (Begin with simpler operations – addition, subtraction, one-step, etc. Continue to use the box throughout the week and gradually increase the complexity of the relationship between input and output.)

Day 2: The Jelly Bean Jar. (Unit 9; Investigation 2.1) Students are given situations in which they begin with a certain number of jelly beans in a jar and the number of jelly beans to add in each round. Students work to create representations showing the relationship between the round number and the number of jelly beans in the jar after each round. Observe the different ways students choose to represent their information (pictures, tables, number sentences, tally marks, words, etc).
*This activity has been changed from the original Investigations lesson. We have chosen to use jelly beans instead of pennies and have condensed the Investigations session to serve the purposes of our unit.

Day 3: Jelly Bean Jar Tables. (Unit 9; Investigations 2.2 & 2.3) Students are given a new jelly bean situation and a table in which to record the number of rounds and total number of jelly beans. Students use the table to demonstrate their understanding of the relationship between two sets of data. Students will be asked to skip rounds without listing all of the rounds in between. Discuss how to represent the relationship using arithmetic expressions and a table that includes space for calculations. Refer to the "input/output machine" and describe the calculation section of the table as a way to see what is happening inside the machine.
*This activity has been changed from the original Investigations lesson. We have chosen to use jelly beans instead of pennies and have condensed the Investigations sessions to serve the purposes of our unit.

Day 4: Windows & Towers. (Unit 9; Investigations 2.5 & 2.6) Students build single and double towers using interlocking cubes and record the relationship between numbers of floors (layers of cubes) and numbers of windows (convex and concave parts) using a table and arithmetic expressions. If time allows, students can also work to build and analyze square and corner towers.
*This activity has been changed from the original Investigations lesson. We have condensed the Investigations sessions to serve the purposes of our unit.

Day 5: Rules for Windows and Towers. (Unit 9; Investigation 2.8) Begin with a class discussion about finding rules for the number of floors and windows in a single tower. Use the "input/output machine" to isolate one set of data from a table and encourage students to discover the arithmetic expression used to represent the relationship between input and output. Students then work in pairs or small groups to determine the arithmetic expression for double towers and if time allows, square and corner towers.
*This activity has been changed from the original Investigations lesson. We have condensed the Investigations session to serve the purposes of our unit.

Day 6: What's the Rule? Students work to analyze patterns in tables representing everyday situations. Students will discover the rule that describes the relationship between input and output and fill in missing numbers in the table. Students will also answer questions of varying difficulty about each table. Begin with a scenario involving the relationship between number of students and number of socks and invite student volunteers to act out the data that will be recorded in a table. Remind students how to go about finding the relationship between two sets of data. Students work two problems in pairs or small groups. Use two more problems as a

mini-assessment. Identify and work with struggling students and offer an extension activity for students who complete the assessment with ease.

Day 7: Table Match Game & Pattern Block Table. Students play a table matching game in groups to practice finding relationships between sets of data. In the game, students will identify tables whose sets of data correctly represent a given everyday situation. Students will be asked to justify their reasoning and look at tables for at least eight different situations. As groups finish the game, students begin to work individually on "Pattern Block Table". In this activity, students will recreate a pattern-block figure and begin to fill in a table showing the number of different pattern blocks used to create the figure. Then, students will complete the table to show the number of different shapes needed to make multiple copies of the figure. Students will also answer questions to demonstrate their understanding of the relationship between the number of figures and the number of shapes needed to create the figures. Identify struggling students and offer an alternative to "Pattern Block Table" such as the "Pattern Block Fish" Exemplar™.

Day 8: Patterns Unit Assessment. Students complete multiple-choice assessment. After all students have finished, introduce performance task. Students must come to school the following day knowing the ages and birth years of two family members and one pet.

Day 9: Performance Task. Students complete performance task.

Day 10: Share Performance Tasks. Students share one table from completed performance task with the class. Assess completed tables and understanding of relationships between data using a rubric.

Resources Used:
Investigations in Number, Data, and Space: Grade 4 (Second Edition; Copyright 2008)
Unit 9 Book: Penny Jars and Plant Growth: Patterns, Functions, and Change

"Pattern Block Fish" Exemplar™
Exemplars™ Guide, pg. 32

Performance Task: From Age to Age

Your Task:
Using chart paper, you will create many tables comparing age relationships. Each table must include at least 10 input/output pairs. One pair must include your current age. After you have finished each table, you will describe the relationship between the input and output using pictures, numbers, and words.

Step 1:
Choose 2 family members and 1 pet and find out their current ages and the year they were born. (If you don't have a pet, you can make one up, or use a stuffed animal or Webkinz.) Create 3 separate tables that compare your age to the age of each family member/pet you have chosen. (Ex. One table compares your age to your mom's age, one table compares your age to your little brother's age, one table compares your age to your dog's age.) Describe the relationship between your age and your family members'/pet's ages in each table using pictures, numbers, and words.

Step 2:
Did you know that animals age at different rates than humans? Using the information chart provided, create a table that compares human years to pet years for your pet. Describe the relationship between human years and pet years using pictures, numbers, and words. How old is your pet now in pet years?

Step 3:
Use the "Mix & Match" chart provided to create 2 more separate tables. You may either choose to compare your age to the age of one of the items from the "Mix & Match" chart, or you may choose to compare 2 items from the chart. (You may do both since you have to make 2 tables! ☺) You will need to use the given birth years to calculate the age of your selection before you organize your information in a table. Describe the relationship between the input and output for each table using pictures, numbers, and words.

Use with Step 2.

Pet Information Chart

Pet	Approximate Number of Pet Years Compared to One Human Year
Cat	5
Dog	7
Ferret	8
Geckos/Iguanas	3
Frog	6
Gerbil/Hamster	25
Goldfish	13
Guinea Pig	20
Lizard	26
Mouse	40
Parakeet	8
Rabbit	11
Snake	4
Turtle	1

Use with Step 3.

Mix and Match Chart

Item	Birth Year
Hannah Montana/Miley Cyrus	1992
Zach and Cody	1992
United States of America	1776
Texas (as a U.S. state)	1845
Hardy Oak Elementary	2000
Your Favorite Book	Look at copyright date!
Your Favorite Author	Look it up!
Tony Hawk	1968
Michael Jordan	1963
Tim Duncan	1976
Dirk Nowitzki	1978
Texas A&M	1876
University of Texas	1883
Great Wall of China	200 B.C.
King Arthur (Legendary)	500 A.D.
Tyrannosaurus Rex	68,000,000 B.C.
Miss Susong	1981
Mrs. Lesher	1983
Your Book Buddy	Go ask!

Extension Activities

Directions: You may choose any or all of the questions below to complete. You must prove your work for every extension question using pictures, numbers, or words.

- Calculate your age in pet years. (Ex. If you have a cat, how old would you be today in cat years?)

- Is there ever a time when you were or you will be twice as old as a family member/pet? Is there ever a time when a family member/pet was or will be twice as old as you? How do you know?

- Look at the pet information chart. If you could be any pet on the chart, which would you be and why? Use pet years and math language to explain your reasoning.

- Look at the pet information chart. Which pets age twice as fast as other pets? Can you make any other observations like this one?

- Make a **timeline** and label it with all the items on the "Mix and Match" chart.

From Age to Age Performance Task Rubric

	Understanding	Table/Completion Accuracy	Written Communication	Presentation
4 EXPERT	▪ Student uses appropriate strategies to show the relationship between input and output for each table. ▪ Student completely addresses assigned steps in the task. ▪ Student's work shows a deep understanding of the task.	▪ All tables are complete and labeled (no missing data). ▪ All tables show data in an organized format (progressing sequentially) ▪ Student correctly calculates relationships between input and output. ▪ Student correctly calculates ages of selections.	▪ Procedures are organized so others can follow it. ▪ Student uses two or more forms of communication (pictures, numbers, and/or words) to clearly explain the relationship between input and output. ▪ Student's written communication is thorough and proves relationship for more than one example.	▪ Student clearly explains the reasoning used to find input/output relationships in the table presented. ▪ Student uses math language effectively to explain their thinking. ▪ Student uses the table and written communication thoughtfully in their presentation.
3 PRACTITIONER	▪ Student uses appropriate strategies to show the relationship between input and output for each table. ▪ Student addresses assigned steps in the task. ▪ Student's work shows a thorough understanding of the task.	▪ All tables are complete and labeled(no missing data). ▪ All tables show data in an organized format (progressing sequentially) ▪ Student calculates relationships between input and output with minimal errors. ▪ Student calculates ages of selections with minimal errors.	▪ Procedures are organized and can be followed by others. ▪ Student uses one form of communication (pictures, numbers, and/or words) to clearly explain the relationship between input and output. ▪ Student's written communication proves relationship for more than one example.	▪ Student explains the reasoning used to find input/output relationships in the table presented. ▪ Student uses some math language to effectively explain their thinking. ▪ Student uses the table and written communication to assist in their presentation.
2 APPRENTICE	▪ Student uses strategies to show the relationship between input and output for each table. ▪ Student addresses some assigned steps in the task. ▪ Student's work shows a limited understanding of the task.	▪ Most tables are complete and labeled (little missing data). ▪ Most tables show data in an organized format (progressing sequentially) ▪ Student calculates relationships between input and output with some errors. ▪ Student calculates ages of selections with some errors.	▪ Procedures are somewhat difficult for others to follow. ▪ Student begins to use communication (pictures, numbers, and/or words) to explain the relationship between input and output. ▪ Student's written communication begins to prove relationship between input and output.	▪ Student begins to explain the reasoning used to find input/output relationships in the table presented. ▪ When prompted, student can use some math language to explain their thinking. ▪ Student begins to use the table and written communication to assist in their presentation.
1 NOVICE	▪ Student does not use strategies to show the relationship between input and output for each table. ▪ Student does not address assigned steps in the task. ▪ Student's work does not show understanding of the task.	▪ Tables are not complete or labeled. ▪ Tables do not show data in an organized format (progressing sequentially). ▪ Student calculates relationships between input and output with many errors. ▪ Student calculates ages of selections with many errors.	▪ Procedures are not organized. ▪ Student does not use written communication to explain the relationship between input and output. ▪ Student's written communication does not prove relationship between input and output.	▪ Student does not explain reasoning used to find input/output relationships in the table presented. ▪ Student cannot use math language to explain their thinking. ▪ Student does not use the table and written communication to assist in their presentation.